gas-metal system, is defined as the change in Gibbs Free Energy, in Joules per mol, that would be required to force one more mol of a gas into a large gas/metal system, at its present free energy state, while holding the temperature, pressure and the concentration of other species constant. The chemical potential, μ, of the deuterium gas is given by the equation:

$$\mu = (0.5RT)\mathrm{Log}_n(P/P_0) \qquad \text{(Equation 1)}$$

where: μ is the gas chemical potential (J/mol), R is the gas constant (8.32 Joules/mol°K), T is the temperature in Kelvin, P is the deuterium gas pressure in atmospheres and P_0 is the selected standard state pressure of 1 atmosphere. Since the chemical potential of the dissolved deuterium is a function of the D gas chemical potential, it is also a function of the two control variables, T and P.

Host metal selection:

The threshold deuterium gas chemical potential may vary from one candidate host material lot to another. The threshold D chemical potential for a specific host metal is also dependent on the system's electronic Fermi energy as well as other factors including the purity, crystal size and regularity, and the population of flaws, cracks, vacancies, distortions and dislocations in the crystal lattice structure of a particular host material. Some of these micro-properties might be altered in the process of installing the host inside of the reactor.

Because of this variation in micro-properties, each lot of the candidate metals is subjected to screening tests, in their final form, to determine their threshold deuterium gas chemical potentials. Such screening tests are conducted for any candidate host metal in a properly instrumented pressure vessel. The material-form combinations with the lowest threshold chemical potentials are the best candidates. The final selection of a metal/form will be dictated by the application requirements.

The 'instrumented' pressure vessel for screening the candidate host materials is called a 'scanning' reactor with means for temperature and deuterium gas pressure control. For the scanning reactor to be an effective tool for the process of selecting the host metal and form, it is designed for a broad operating range in terms of high D chemical potentials, high temperatures and high pressures. When the reactor body is made from pure tungsten, D chemical potentials up to the range of 70 kJ/mol,